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By pass fat in animal feeding-A review

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Abstract
Fats which are not protected have a depressing effect on rumen cellulolytic microbial activity reducing polyunsaturated fatty acids and increasing saturated fatty acids content in milk fat that are atherogenic, and raise the risk of cardiovascular disease. Bypass fat in rations of the high producing dairy animals is very crucial for enhancing the energy density of the ration. Supplementation of bypass fat had no adverse effect on the rumen fermentation, feed intake and digestibility of nutrients and different blood parameters of the dairy animals. The milk yield is increased along with the improvement in post partum recovery of the body weight and body condition score and reproductive performance of the dairy animals. Choline is a constituent of phospholipid and acts as a methyl donor. It contributes to fat export from the liver via playing a vital role in the synthesis of very low density lipoprotein and consequence metabolism of fat for energy production and increases milk production. Additional study is essential to find out the supplementary effect of the bypass fat on dairy animals fed various types of basal rations as diverse productive levels and stages of lactation.

Keywords: Bypass fat, Rumen, NEFA, Negative energy balance, Choline

1. Introduction
In India, buffaloes contribute a major part of high fat milk and during early lactation, the amount of energy required for maintenance of body tissues and milk production often exceeds the amount of energy available from the diet, causes negative energy balance (Bell *et al.*, 1995) [3], thus forcing mobilization of body fat reserves to satisfy energy requirement. Due to the decreased feed intake at the end of gestation, the negative energy balance period often starts prior to calving (Van den Top *et al.*, 1995) [28].

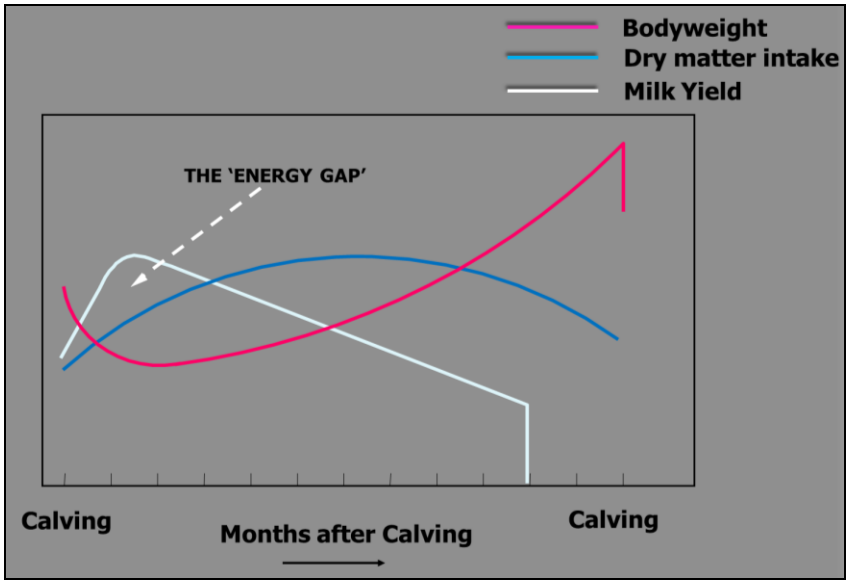

Fig 1: Interrelation of bodyweight, dry matter intake and milk yield.

The negative energy balance in early lactation causes delayed post-partum ovarian activity (Garnsworthy and Webb 1999) [12], apart from affecting peak milk yield and overall lactation yield. The level of non-esterified fatty acids (NEFA) increases in plasma as a consequence of

body fat mobilization (Reid and Collins, 1980) [24] and leads to hepatic lipidosis. In initial lactation to meet their energy requirement of high yielding crossbred animals, they should be fed with either higher level of cereal grains or fed on a diet supplemented with bypass nutrients. But excess of cereal grains in the diet can cause rumen acidosis predisposing the animals to ill health, animal goes off feed, leading to drop in milk yield.

2. Use of dietary fat in dairy animals

In ration of early lactating or high yielding dairy animals, fat is helpful in increasing the energy density of the diet which is 2.25 times than carbohydrate. The supplementation of fat in animals rations checks negative energy balance during early lactation, acidosis and laminitis, subordinate heat production and integrate fatty acid into milk fat.

2.1 Rumen-active fat

Raw edible oil if given beyond a certain proportion as a source of fat for increasing energy density of the ration may adversely affect fiber digestion and bind divalent mineral ions. Fats which are not protected causes physical and chemical changes in the microbial fermentation of feed that are generally negative, and feeding of free or unprotected fat above 1% level has a depressing effect on rumen cellulolytic microbial activity (Palmquist, 1991) [20]. Milk fat is criticized for having higher content of saturated fatty acids and lower content of polyunsaturated fatty acids that are atherogenic, and raise the risk of cardiovascular disease by increasing plasma cholesterol and low density lipoproteins (LDL). The amount and composition of milk fat can be influenced by means of feeding. Most strategies involve supplementing diet with plant oils or oil seeds (Abu Ghazaleh and Holmes 2009, Baer *et al*. 2001) [1, 2].

2.2 What is by pass fat

It is a type of fat which have high melting point remaining insoluble at rumen temperature and have no harmful effect on rumen fermentation. The objective of bypassing rumen is to save the beneficial unsaturated fatty acids from microbial bio-hydrogenation (Parodi 1999) [22].

2.3 Natural bypass fat

Whole oil seeds with hard outer seed coat, which protects the internal fatty acids from lipolysis and bio-hydrogenation in the rumen (Ekeren *et al.,* 1992) [7]. oil seeds cakes commonly used in the ration of dairy animals are cotton, roasted soybeans, sun flower and canola.

2.4 Crystalline or prilled fatty acids

Crystalline or prilled fatty acids can be made by liquifying and spraying the saturated fatty acids under pressure into cooled atmosphere causes increase in melting point of the fatty acids which do not melt at ruminal temperature, resisting rumen hydrolysis and association with bacterial cells or feed particles thus by pass rumen degradation and digested in small intestine by lipase enzyme and make available energy for the productive processes such as lactation (Chalupa *et al*., 1986) [5].

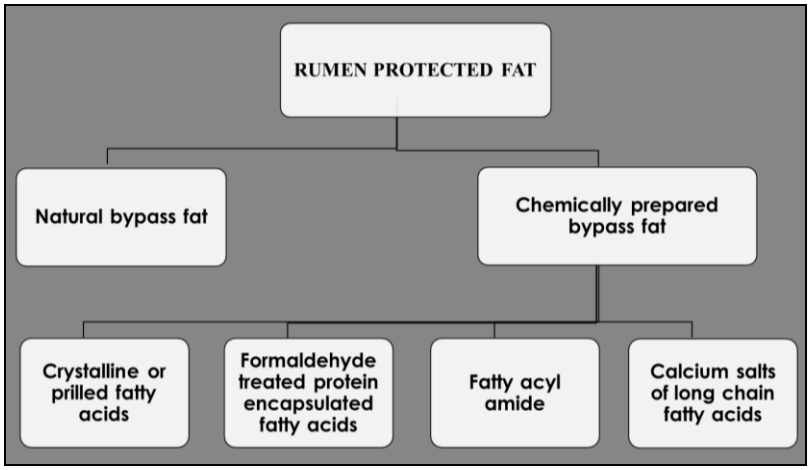

Fig 2: Types of rumen protected fat

2.5 Formaldehyde treated protein encapsulated fatty acids

Formaldehyde treated protein encapsulated fatty acids is also an affecting means of protecting dietary fat from rumen hydrolysis (Sutton *et al*., 1983) [27]. Casein-formaldehyde coated fat has been used by the earlier workers (Bines *et al*., 1978) [4]. Oil seeds can be crushed and treated with formaldehyde (1.2 g per 100g protein) in plastic bags or silos and kept for about a week. The drawback of Formaldehyde treated protein encapsulated fatty acids is that in some cases it bypasses whole GIT.

2.6 Fatty acyl amide

Fatty acyl amide can be prepared and used as a source of bypass fat. Butylsoyamide is a fatty acyl amide consisting of an amide bond between soy fatty acids and a butylamine (Jenkins, 1998) [15]. Conversion of oleic acid to fatty acyl amide (oleamide) enhance the post-ruminal flow of oleic acid and mono-unsaturated fatty acids concentration of the milk, when fed to dairy cows (Lundy *et al.,* 2004) [16].

2.7 Calcium salts of long chain fatty acids

Calcium salts of long chain fatty acids (Ca-LCFA) are insoluble soaps produced by reaction of the carboxyl group of long chain fatty acids (LCFA) and calcium salts (Ca++). Degree of the insolubility of the Ca soaps depends upon the rumen pH and type of fatty acids. When rumen pH is more than 5.5, Ca-LCFA is inert in rumen. In acidic pH of the abomasum, fatty acids are dissociated from Ca-LCFA and then absorbed efficiently from the small intestine. Among all forms of bypass fat, Ca-LCFA is relatively less degradable in the rumen (Elmeddah *et al.,* 1991) [9], has a highest intestinal digestibility and serves as an additional source of calcium (Naik *et al.,* 2007) [18].

Table 1: specification of bypass fat (ca-lcfa) supplement.

Characteristic	Requirement
Moisture	4-5
Fat content	80-84
Calcium content	7-9
Colour	Light brown to pale yellow
Physical appearance	Free flowing granules
Protection	78-82

Naik *et al*., 2007

2.8 Preparation of calcium salts of long chain fatty acids

Concentrate sulphuric acid (120 ml) in 500 ml tap water was mixed with in 4 kg hot rice bran oil (RBO). After a few minutes (when effervesces almost subsided), 1.6 kg technical grade calcium hydroxide dissolved in 10 L water, was added to it and boiled for 30 minutes without cover on medium heat. When the Protected Fat became granular and non-sticky, it was filtered through a cloth with repeated washings under running tap water and was sun dried. The Protected Fat was kept in an air tight container in a cool place after mixing with butylated hydroxy toluene (BHT) @ 0.05% as an antioxidant. (Naik *et al*, 2007) [18].

2.9 By pass fat (palm fatty acid distillate) manufactured at nddb:

Fatty acid composition of palm fatty acid distillate (PFAD) based bypass fat	
Name of fatty acid	**Content**
Palmitic acid (C16:0)	46-49
Oleic acid (C18:1)	36-38
Linoleic acid (C18:2)	7-8
Stearic acid (C18:0)	4-6
Myristic acid (C14:0)	1.1-1.4
Lauric acid (C12:0)	0.2-0.3

www.nddb.coop

3 Effect of bypass fat

By pass fat is the most energy dense nutrient available that overcome the deleterious effect of fats having a low melting point on fiber digestibility, feed intake and absorption of magnesium and calcium. Bypass fat helps in overcoming this negative energy balance phenomenon. Rumen inert fat (Ca salt of fatty acid) is partially resistant to bio-hydrogenation by the rumen microbes and reduces the risk of metabolic acidosis (Naik *et al*. 2009) [19].

3.1 Effect on reproduction

Supplementation of Ca-LCFA in the diet had a positive effect on reproductive performance of dairy cows, which is further dependent up on the specific fatty acids profile of the Ca salt. Feeding Ca-LCFA increases pregnancy rate and reduces open days (Sklan *et al*., 1991) [26]. Hypotheses are suggested regarding the role of the fatty acids on reproductive performance of dairy animals (Sklan *et al*., 1994) [25]. These include improved energy balance results in an earlier return to post-partum ovarian cycling; increase linoleic acid may provide increase $PGF_2\alpha$ and stimulate return to ovarian cycling and improve follicular recruitment; and Increase in progesterone secretion either from improved energy balance or from altered lipoprotein composition from dietary fat improves fertility.

3.2 Effect on body weight and body condition

Body condition score (BCS) provides the best estimate of body fat distribution than body weight (Ferguson *et al*., 1994) [10]. Garg and Mehta (1998) [11] observed that the BSC of the cows improved due to bypass fat feeding indicating reduction in weight loss in the first quarter and helped gaining substantially after 90 days of feeding. There is the better recovery in BW, ADG and BSC in crossbred cows during early lactation in bypass fat supplemented group.

3.3 Effect on milk composition

Hammon *et al*., 2008 [14] observed that milk and lactose yields were higher in RPF fed animals than control. Milk fat percentage and total SNF yield are increased. Further, supplemental effect of bypass fat on milk fat content is dependent up on the level and fatty acid profile of the Ca-LCFA (Naik *et al*., 2009) [19]. Generally, there is negative effect on the milk protein percentage by supplementation of bypass fat (Ca-LCFA) which is due to dilution of milk protein as higher milk volume synthesized is not synchronized with uptake of amino acids by the mammary gland (DePeters and Cantt, 1992) [6]. Additional, dietary fat impairs amino acids transport to mammary gland and induces insulin resistance (Palmquist and Moser, 1981) [21].

3.4 Effect of on economics

The total cost of production of bypass fat prepared by indigenous methods depends up on the cost and availability of the raw ingredients. Bypass fat, prepared by the indigenous methods is reasonable and inexpensive.

4 Level of bypass fat

The promising result of feeding Ca salt of fatty acid was more obvious at the early lactation, and maximum response was observed with the addition of 2–3% of bypass fat (150– 300 g/day). This improved the milk yield and feed efficiency in lactating cattle and buffaloes.

5 How bypass fat works

Bypass fat contains an unsaturated fat related with calcium particles, rather than a glycerol backbone. Fat supplement brought by association of calcium salt and fatty acid has low solubility, less susceptible to bio-hydrogenation and remain inert in the rumen. Though, in the abomasum at acidic pH it dissociates and set free fatty acid and calcium for absorption. The fatty acids are more digestible in the duodenum collectively due to high acidity, the detergent action of bile acids, lysolecithin, and fatty acids.

6 Choline is essential with bypass fat

Normally, choline can be synthesized adequately by the animals but supply of choline in early lactating dairy animals may be insufficient (Pires and Grummer, 2008) [23]. Dietary choline must be supplemented in the protected form because it get degraded rapidly in the rumen (Elek *et al.*, 2008) [8]. Choline is a constituent of phospholipid and acts as a methyl donor. It contributes to fat export from the liver via playing a vital role in the synthesis of very low density lipoprotein and

consequence metabolism of fat for energy production and increases milk production. Significant decrease in serum NEFA level has been stated on feeding Rumen protected choline (Zahra *et al.,* 2006) [29].

7 Accessibility of bypass fat

Bypass fat encompassing diverse levels of fat is available in the marketplace as commercial products.

8 Conclusion

Supplementing bypass fat aides in enhancing milk and fat yield in lactating animals, this can additionally be upgraded by a fortress with rumen protected choline chloride (Garg, 2012) [17].

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10 References

1. AbuGhazaleh AA, Holmes L. Altering dairy cows milk fatty acid composition through grazing and oil supplementation. Milchwissenschaft. 2009; 64(3):241-244.
2. Baer RJ, Ryali J, Schingoethe DJ, Kasperson KM, Donovan DC, Hippen AR et al. Composition and Properties of Milk and Butter from Cows Fed Fish Oil1. Journal of Dairy Science. 2001; 84(2):345-353.
3. Bell AW. Regulation of organic nutrient metabolism during transition from late pregnancy to early lactation. Journal of animal science. 1995; 73(9):2804-2819.
4. Bines JA, Brumby PE, Storry JE, Fulford RJ, Braithwaite GD. The effect of protected lipids on nutrient intakes, blood and rumen metabolites and milk secretion in dairy cows during early lactation. The Journal of Agricultural Science. 1978; 91(1):135-150.
5. Chalupa W, Vecchiarelli B, Elser AE, Kronfeld DS, Sklan D, Palmquist DL. Ruminal Fermentation In Vivo as Influenced by Long-Chain Fatty Acids1. Journal of Dairy Science. 1986; 69(5):1293-1301.
6. DePeters EJ, Cant JP. Nutritional Factors Influencing the Nitrogen Composition of Bovine Milk: A Review1. Journal of Dairy Science. 1992; 75(8):2043-70.
7. Ekeren PA, Smith DR, Lunt DK, Smith SB. Ruminal biohydrogenation of fatty acids from high-oleate sunflower seeds. Journal of animal science. 1992; 70(8):2574-2580.
8. Elek P, Newbold JR, Gaal T, Wagner L, Husveth F. Effects of rumen-protected choline supplementation on milk production and choline supply of periparturient dairy cows. Animal. 2008; 2(11):1595-1601.
9. Elmeddah Y, Doreau M, Michalet-Doreau B. Interaction of lipid supply and carbohydrates in the diet of sheep with digestibility and ruminal digestion. The Journal of Agricultural Science. 1991; 116(3):437-445.
10. Ferguson JD, Galligan DT, Thomsen N. Principal descriptors of body condition score in Holstein cows. Journal of dairy science. 1994; 77(9):2695-2703.
11. Garg MR, Mehta AK. Effect of feeding bypass fat on feed intake, milk production and body condition of Holstein Friesian cows. Indian Journal Animal Nutrition. 1998; 15:242-245.
12. Garnsworthy PC, Webb R. The influence of nutrition on fertility in dairy cows. Recent advances in animal nutrition. 1999: 39-58.
13. Grummer RR. Nutritional and management strategies for the prevention of fatty liver in dairy cattle. The Veterinary Journal. 2008; 176(1):10-20.
14. Hammon HM, Metges CC, Junghans P, Becker F, Bellmann O, Schneider F et al. Metabolic changes and net portal flux in dairy cows fed a ration containing rumen-protected fat as compared to a control diet. Journal of dairy science. 2008; 91(1):208-217.
15. Jenkins TC. Fatty Acid Composition of Milk from Holstein Cows Fed Oleamide or Canola Oil1. Journal of dairy science. 1998; 81(3):794-800.
16. Lundy FP, Block E, Bridges WC, Bertrand JA, Jenkins TC. Ruminal biohydrogenation in Holstein cows fed soybean fatty acids as amides or calcium salts. Journal of dairy science. 2004; 87(4):1038-1046.
17. Garg MR, Sherasia PL. Effect of Supplementing Bypass Fat with Rat with Rumen Protected Choline Chloride on Milk Yield, Milk Composition and Metabolic Profile in Crossbred Cows. Indian Journal of Dairy Science. 2012; 65(4): 319-323.
18. Naik PK, Saijpaul S, Rani N. Evaluation of rumen protected fat prepared by fusion method. Anim. Nutr. Feed Technol. 2007; 7:95-101.
19. Naik PK, Saijpaul S, Sirohi AS, Raquib M. Lactation response of cross bred dairy cows fed on indigenously prepared rumen protected fat-A field trial. Indian Journal of Animal Sciences. 2009; 79(10):1045.
20. Palmquist DL. Influence of Source and Amount of Dietary Fat on Digestibility in Lactating Cows1, 2. Journal of Dairy Science. 1991; 74(4):1354-1360.
21. Palmquist DL, Moser EA. Dietary Fat Effects on Blood Insulin, Glucose Utilization, and Milk Protein Content of Lactating Cows1, 2. Journal of Dairy Science. 1981; 64(8):1664-1670.
22. Parodi PW. Conjugated linoleic acid and other anticarcinogenic agents of bovine milk fat. Journal of Dairy Science. 1999; 82(6):1339-1349.
23. Pires JA, Grummer RR. Micronutrients and their impact on high performing dairy cows-A focus on niacin and choline. InProc. Southwest Nutrition and Management Conference, Department of Animal Sciences, University of Arizona 2008.
24. Reid IM, Collins RA. The pathology of post-parturient fatty liver in high-yielding dairy cows. Investigative & cell pathology. 1980; 3(3):237-249.
25. Sklan D, Kaim M, Moallem U, Folman Y. Effect of dietary calcium soaps on milk yield, body weight, reproductive hormones, and fertility in first parity and older cows. Journal of Dairy Science. 1994; 77(6):1652-1660.
26. Sklan D, Moallem U, Folman Y. Effect of feeding calcium soaps of fatty acids on production and reproductive responses in high producing lactating cows. Journal of dairy science. 1991; 74(2):510-517.
27. Sutton JD, Knight R, McAllan AB, Smith RH. Digestion and synthesis in the rumen of sheep given diets supplemented with free and protected oils. British Journal of Nutrition. 1983; 49(3):419-432.
28. Van Den Top AM, Wensing T, Geelen MJ, Wentink GH, Van't Klooster AT, Beynen AC. Time Trends of Plasma Lipids and Enzymes Synthesizing Hepatic Triacylglycerol During Postpartum Development of Fatty Liver in Dairy Cows1. Journal of dairy science. 1995; 78(10):2208-2220.
29. Zahra LC, Duffield TF, Leslie KE, Overton TR, Putnam

D, LeBlanc SJ. Effects of rumen-protected choline and monensin on milk production and metabolism of periparturient dairy cows. Journal of dairy science. 2006; 89(12):4808-4818.